Education Week
Volume :24, Issue 01, 2004-09-01 p 56,44

Preparing Students for Work In a Computer-Filled Economy

By Frank Levy & Richard J. Murnane

More than half of all American workers use a computer at work, and the percentage is growing rapidly. How should American schools prepare students to thrive in workplaces filled with computers? The answer begins by understanding the work that computers can and cannot do well, so that students can be prepared for work computers will not be doing.

Start by taking a broad look at the workplace tasks people do in any economy. Every job requires the processing of information. Whether it's words on a page, numbers in a report, the look on a customer's face, the taste of a sauce, the sound of a stumbling automobile engine-people in their daily work process all this information as they decide what to do next. Computers excel at carrying out those information-processing tasks that can be defined in terms of a sequence of rules. Filing and bookkeeping and repetitive manufacturing work are prototypical examples, but others now include issuing airport boarding passes and evaluating mortgage applications. Rules-based tasks are not only the easiest to computerize; they are also the easiest to send offshore to lower-wage countries. In the case of an Indian call center, the "rules" take the form of a step-by-step script that provides responses to most customer questions. As a result of computerization and outsourcing, work for a growing percentage of Americans consists of tasks in which information cannot be processed simply by following rules.

There are three types of workplace tasks that cannot be carried out by following a sequence of rules. The first is identifying and solving new problems-if the problem is new, there are no rules for solving it. We call this kind of problem-solving "expert thinking." A second set of tasks consists of complex human interactions, including leading, teaching, marketing, and negotiating. These tasks cannot be accomplished effectively by following rules because they involve processing vast amounts of information, only some of which is verbal and much of which may be unanticipated when the interaction starts. We call this interactive ability "complex communication." A third type of workplace task that cannot be described in rules is a set of "simple" physical activities that figure prominently in service-sector jobs like janitorial work, waiting on tables, and security-guard patrols. From a computer's perspective, these jobs are not simple at all, something we can appreciate when we think about what the eye and brain must do to process light hitting the retina into three-dimensional models of the world.

As computers replace humans in rules-based tasks, both directly and by facilitating outsourcing, they have helped dramatically alter the U.S. occupational distribution. The job categories that have grown in importance between 1969 and 1999 are at the two ends of the wage distribution. On the low-wage end, there has been growth in the number of service-sector jobs that almost all humans can do, but which are very difficult to program computers to do. At the high-wage end, there has been growth in the numbers of sales, technical, professional, and managerial jobs-jobs that computers do not do well, but that well-educated humans do.

The job categories that have declined in importance are administrative-support work and blue-collar work-principally production jobs-that are in the lower middle of the wage distribution. These are the job categories that, historically, provided work for American high school graduates who did not go to college. In this evolving occupational distribution, those students who leave high school with the skills to succeed in the college programs needed to gain access to technical, managerial, and professional jobs will do fine. Those who leave high school without these skills will find themselves competing for the low-wage service jobs.

How can schools prepare students to gain access to and thrive in the growing number of technical and professional jobs? ***The key is increasing students' ability to engage in expert thinking and complex communication***, the two terms we defined above. We do not see expert thinking and complex communication as new subjects to add to the curriculum. Instead, they should be central to the pedagogy for teaching the traditional subjects, all of which retain their importance.

Reading and mathematics are the tools by which students acquire knowledge, and knowledge is critical to expert thinking in any subject domain. Writing is important because it is a key element of complex communication. Science and social studies are at least as important to work and life in a pluralistic democracy as they ever were. ***What is of growing importance is that instruction in all these core subjects emphasize identifying and solving problems and the listening, speaking, and writing skills that are central to effective communication.***

You will note that we have not mentioned computer skills. In the computerized workplace, a basic understanding of computers is required for most jobs. Providing all students with basic computer skills is a challenge that has been largely met-if facility with computers is defined narrowly.

A 1999 National Research Council report, "Being Fluent With Information Technology," provides a list of "information-technology skills" that includes: using basic operating-system features, using a word processor to create a text document, using the Internet to find information and resources, and using a computer to communicate with others. While a "digital divide" existed 15 years ago between students with these skills and those who lacked them, the increasing availability of computers in schools, homes, and libraries has to a large extent eliminated that divide.

Today's digital divide occurs at a higher level-between students who can use a computer to do valuable work and those who cannot. The same National Research Council report on information technology includes a second list, labeled "intellectual capabilities." Items on this list include: engaging in sustained reasoning, managing complexity, testing solutions, evaluating information, collaborating, and communicating to other audiences.

We see this second list as strikingly similar to the elements of expert thinking and complex communication, capabilities that will determine whether students gain access to the growing number of well-paid jobs or are relegated to the relatively low-paying jobs in the service sector. For this reason, ***the focus in schools should be on using computers as tools in working on problem-solving and complex communication tasks that are at the center of instruction in the core school subjects.***

As the country starts a new school year, it is a good time to consider whether our schools are preparing students to thrive in a society full of computers. Two students' responses to a teacher's questions about a historical event illustrate the challenge. This example is taken from a 2001 report from the National Research Council, "Knowing What Students Know: The Science and Design of Educational Assessment":

Student No. 1

Q. What was the date of the battle of the Spanish Armada?

A. 1588

Q. How do you know this?

A. It was one of the dates I memorized for the exam.

Q. Why is the event important?

A. I don't know.

Student No. 2

Q. What was the date of the battle of the Spanish Armada?

A. It must have been around 1590.

Q. How do you know this?

A. I know the English began to settle in Virginia just after 1600, although I'm not sure of the exact date. They wouldn't have dared start overseas explorations if Spain still had control of the seas. It would have taken a little while to get expeditions organized, so England must have gained naval supremacy somewhere in the late 1500s.

Q. Why is the event important?

A. It marks a turning point in the relative importance of England and Spain as European powers and colonizers of the New World.

Only instruction that prepares students to give the second type of answers will prove valuable in a society filled with computers. And so, it is appropriate to ask in every subject: Is this the kind of instruction we are providing?

Frank Levy and Richard J. Murnane, both economists, are, respectively, the Daniel Rose professor of urban economics at the Massachusetts Institute of Technology and the Thompson professor of education and society at Harvard University, both in Cambridge, Mass. This essay is based on their book The New Division of Labor: How Computers Are Creating the Next Job Market, which Princeton University Press and the Russell Sage Foundation published in June.